

AD-A284 670



FINAL REPORT

Office of Naval Research

Grant No. N00014-90-J-1581

for

Partial Funding of Gordon Research Conference

"Fundamental Interactions of Water with Solid Surfaces"

July 16-20, 1990

Kimball Union Academy

Meriden, NH

DTIC
ELECTE
SEP 21 1994

D

94-30234



1598

Submitted by:

Theodore E. Madey

Theodore E. Madey
Serin Physics Laboratory
Rutgers, The State University
of New Jersey
P. O. Box 849
Piscataway, NJ 08855-0849
Tel. (201) 932-5185
FAX (201) 932-4343

AMC

A. M. Cruickshank *dy*
Director
Gordon Research Conferences
University of Rhode Island
Kingston, Rhode Island 02881-0801

**Best
Available
Copy**

AD NUMBER		DATE 11/12/94	DTIC ACCESSION NOTICE
1. REPORT IDENTIFYING INFORMATION			REQUESTER: 1. Put your mailing address on reverse of form. 2. Complete items 1 and 2. 3. Attach form to reports mailed to DTIC. 4. Use unclassified information only. DTIC: 1. Assign AD Number. 2. Return to requester.
A. ORIGINATING AGENCY Office of Naval Research			
B. REPORT TITLE AND/OR NUMBER Fundamental Interactions Partial Funding of Gordon Research			
C. MONITOR REPORT NUMBER Gordon Research			
D. PREPARED UNDER CONTRACT NUMBER N00014-90-J-1581			
2. DISTRIBUTION STATEMENT a.			

DTIC FORM 50
FEB 86

PREVIOUS EDITIONS ARE OBSOLETE

1990 Gordon Research Conference on
 "Fundamental Interactions of Water with Solid Surfaces"

The Gordon Conference on the "Fundamental Interactions of Water with Solid Surfaces" was held from July 16 to 20, 1990 at the Kimball Union Academy in Meriden, NH. The Chairman was Theodore E. Madey of Rutgers University; the Vice-Chairperson was Patricia A. Thiel of Iowa State University. The conference attracted sixty participants; about twenty five percent were from foreign countries, including Canada. There was a good mixture of scientists from universities, national laboratories and private industries, including young scientists and graduate students as well as established scientists.

The program brought together people working in rather different areas, including surface chemistry and physics, electrochemistry, corrosion, wetting, fracture, and processing of semiconductors. The program included eighteen lecturers and nine discussion leaders. The discussion following the talks was unusually active and stimulating, and a large percentage of the attendees contributed to the discussion.

There were a number of exciting new results presented and discussed. P. Norton presented high sensitivity reflection infrared absorption spectroscopic measurements of H_2O on $Ni(110)$, and correlated his results with absolute coverage determinations. Bonzel and White discussed the role of surface additive atoms on the structure and chemistry of H_2C , and demonstrated that a "critical coverage" of adsorbed alkali is necessary for H_2O dissociation to occur. Molecular dynamics simulations of H_2O on metal and oxide surfaces were well covered by Spohr and Garofalini, and their results provided new insights into the structure and reactivity of adsorbed H_2O . Stuve and Wagner described the linkage between surface science and electrochemistry in H_2O -solid interactions, and Wagner reported positive evidence for adsorbed hydronium, H_3O^+ . Chabal described the use of aqueous HF for producing atomically smooth and clean $Si(111)$ surfaces, and Sinclair described the problems caused by moisture in failure of semiconductor electronics.

The role of moisture in fracture of brittle materials was discussed by Lawn, and Porter presented exciting evidence for the structure of H_2O layers between two surfaces at distances of the order 1 nm. Dubois provided the first convincing data showing the relation between surface science (thermal desorption) measurements and macroscopic wetting of surfaces. Finally, Campbell and Kasemo described detailed kinetic schemes for the formation and decomposition of H_2O .

DTC QUALITY REPORT

There were two poster sessions containing a total of twenty four posters of high calibre. All reports I received indicated that the conference was successful and stimulating. The next Gordon Conference on this subject will be scheduled in four to five years, under the chairmanship of Prof. Patricia Thiel, Iowa State University.

Attachments:

1. Conference Program
2. List of Poster Presentations
3. Attendance List

Accession For	
NTIS CRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By	
Distributic	
Availability Codes	
Dist	Avail and/or Special
A-1	

GORDON RESEARCH CONFERENCE

"Fundamental Interactions of Water With Solid Surfaces" Kimball Union Academy, Meriden, New Hampshire

Theodore E. Madey, Chairman
Rutgers University

Patricia A. Thiel, Vice Chairman
Iowa State University

July 16-20, 1990

Sunday, July 15, 1990

7:00 p.m. Dinner

8:00 p.m. Mixer

Monday, July 16, 1990

8:45 a.m. Introductory Remarks

Morning Session: Water-Metal Interactions

Carsten Benndorf, Discussion Leader

9:00 a.m. Peter Norton
University of Western Ontario

"Interaction of Water with Nickel and
Aluminum Surfaces: Absolute
Coverages, Ordering and Dynamics"

9:50 a.m. Discussion

10:20 a.m. Coffee; Conference Photograph

10:40 a.m. Jose M. Heras
University Nacional de La Plata,
Argentina

"Water on Polycrystalline Metal
Surfaces"

11:30 a.m. Discussion

12:30 p.m. Lunch

Evening Session: Water Interactions With Additives

Galen B. Fisher, Discussion Leader

7:00 p.m. H. P. Bonzel
KFA Julich

"Alkali-Modified Adsorption of
Water"

7:35 p.m. Discussion

8:00 p.m. J. M. White
University of Texas

"Surface Science of Coadsorbate
Overlayers Involving Water"

8:35 p.m. Discussion

Tuesday, July 17, 1990

Morning Session: Theory of H₂O Layers on Surfaces

Uzi Landman, Discussion Leader

- | | | |
|------------|---|---|
| 9:00 a.m. | Eckhard Spohr
University of California | "Computer Simulations of Water on
Metal Surfaces" |
| 9:50 a.m. | Discussion | |
| 10:25 a.m. | Coffee | |
| 10:40 a.m. | J. Woods Halley, Jr.
University of Minnesota | "Electronic Structure and Dynamics at
the Water/Electrode Interface" |
| 11:30 a.m. | Discussion | |
| 12:30 p.m. | Lunch | |

Evening Session: Water at Oxide Surfaces

Richard L. Kurtz, Discussion Leader

- | | | |
|-----------|---|--|
| 7:00 p.m. | Victor E. Henrich
Yale University | "The Interaction of Water with Perfect
and Defect Surfaces of Semiconductors
and Oxides" |
| 7:35 p.m. | Discussion | |
| 7:50 p.m. | Stephen H. Garofalini
Rutgers University | "Water Interactions with Oxide Glass
Surfaces - Molecular Dynamics
Simulations" |
| 8:25 p.m. | Discussion | |
| 8:40 p.m. | Poster Session | |

Wednesday, July 18, 1990

**Morning Session: Electrochemical Aspects of Water-Surface
Interactions**

P. N. Ross, Jr., Discussion Leader

- | | | |
|------------|---|--|
| 9:00 a.m. | Eric Stuve
University of Washington | "In-Situ and Ex-Situ Studies of
Electrochemical Phenomena" |
| 9:50 a.m. | Discussion | |
| 10:25 a.m. | Coffee | |
| 10:40 a.m. | Frederick T. Wagner
General Motors Research Labs | "UHV Investigations of Surface
Solvation Effects in Electrochemistry" |
| 11:30 a.m. | Discussion | |
| 12:30 a.m. | Lunch | |

Evening Session: Interaction of Water With Electronic Materials

Patricia M. George, Discussion Leader

- | | | |
|-----------|--|--|
| 7:00 p.m. | Yves Chabal
AT&T Bell Laboratories | "Infrared Spectroscopy of Water -
Modified Silicon Surfaces" |
| 7:35 p.m. | Discussion | |
| 7:50 p.m. | J. D. Sinclair
AT&T Bell Laboratories | "The Role of Water in the Degradation
of Electronics: Materials, Mechanisms,
Protection, and Challenges" |
| 8:25 p.m. | Discussion | |
| 8:40 p.m. | Poster Session | |

Thursday, July 19, 1990

Morning Session: Interfacial Phenomena

Bruce Bunker, Discussion Leader

- | | | |
|------------|---|---|
| 9:00 a.m. | Brian Lawn
National Institute of Standards
and Technology | "Surface Forces, Adhesion and Fracture
of Brittle Solids" |
| 9:50 a.m. | Discussion | |
| 10:25 a.m. | Coffee | |
| 10:40 a.m. | John D. Porter
Univ. of California, Berkeley | "Interfacial Structure and Dynamics in
Hg/H ₂ O/Hg Tunnel Junction Devices" |
| 11:30 a.m. | Discussion | |
| 12:30 p.m. | Lunch | |

Evening Session: Wetting Phenomena

Mark O. Robbins, Discussion Leader

- | | | |
|-----------|--|--|
| 7:00 p.m. | Michael Schick
University of Washington | "A Theoretical Overview of Wetting
Phenomena" |
| 7:35 p.m. | Discussion | |
| 8:00 p.m. | Lawrence H. Dubois
AT&T Bell Laboratories | "Wetting of Organic Surfaces:
Microscopic Predictions of a
Macroscopic Observable" |
| 8:35 p.m. | Discussion | |

Friday, July 20, 1990

Morning Session: Reactions of H₂O at Surfaces

John T. Yates, Jr., Discussion Leader

8:45 a.m.	Charles T. Campbell University of Washington	"The Water-Gas Shift Reaction Over Clean and Cs-Promoted Cu Single- Crystal Catalysts: Elementary Processes"
9:35 a.m.	Discussion	
10:00 a.m.	Coffee	
10:15 a.m.	Bengt Kasemo Chalmers Univ. of Technology	"Water Formation and Decomposition on Pt"
11:05 a.m.	Discussion	
12:00 noon	Lunch	

Posters Presented at Gordon Conference

"Fundamental Interactions of Water with Solid Surfaces"

Tuesday, July 17, 1990

Dr. G. Pirug
Institut für Grenzflächenforschung
Forschungszentrum Jülich GMBH
Postfach 1913
D-51170 Jülich 1
Federal Republic of Germany

"The Influence of Alkali Metals on the
Oxidation of Si(100) Surfaces by H₂O"
(Authors: G. Pirug and H. P. Bonzel)

Dr. A. Brodsky
Department of Chemistry
University of Pennsylvania
Philadelphia, PA 19104-6323

"Phase Transitions in Surface Water
Layers"

Professor Jiri Skvarla
Department of Mineral Processing
and Environmental Protection
Technical University
Park Komenskeho 19
043 84 Kosice
Czechoslovakia

"A Correlation Between the Wettability
and Aggregation of Fine Minerals"

Robert Brosseau
Department of Chemistry
University of Montreal
Montreal, Quebec, CANADA

"Water on Pd(110)"
(Authors: R. Brosseau and T. H. Ellis)

Brian W. Callen
Department of Chemistry
University of Western Ontario
CANADA N6A 5B7

"Identification of Surface Water
Molecules on Isotopically Substituted
Ice Layers"
(Authors: Brian W. Callen, K. Griffiths
and P. R. Norton)

Professor J. A. Panitz
Department of Physics and
Astronomy
The University of New Mexico
Albuquerque, NM 87131

"Imaging Atom-Probe Studies of Aqueous
Interfaces"

Eric K. Parks
Argonne National Laboratory
701 Lakeside Drive
Hinsdale, IL 60521

"Reactions of Water with Iron, Cobalt,
and Nickel Clusters"
(Authors: E. K. Parks, S. Riley,
T. Klots and B. Winter)

Stephen James Bushby
 Department of Chemistry
 University of Western Ontario
 London, Ontario
 CANADA N6A 5B7

"Absolute Hydroxyl Coverage of Oxides
 Formed by Water Interaction with
 Al(100)"
 (Authors: S. J. Bushby, K. Griffiths,
 Z. H. Lu, D. K. Greber, R. S. Timsit and
 P. R. Norton)

Si-Chung Chang
 Department of Chemistry
 Purdue University
 West Lafayette, IN 47907-3699

"In-Situ Infrared Spectroscopy of Well-
 Defined Single Crystal Electrodes"
 (Authors: S.-C. Chang and M. Weaver)

Yitzhak Shnidman
 Research Laboratories
 Eastman Kodak Company
 Rochester, NY 14650-2109

"Concentration-Driven Surface Transition
 in the Wetting of Mixed Alkanethiol
 Monolayers"
 (Authors: Y. Shnidman, J. E. Eilers,
 S. D. Evans, R. Sharma, J. C. Chang and
 A. Ulman)

W.-H. Hung
 Department of Chemistry
 Princeton University
 Princeton, NJ 08544

"The Adsorption of H_2O on Clean and
 Oxidized Fe(100)"
 (Authors: W.-H. Hung, J. Schwartz and
 S. L. Bernasek)

Wednesday, July 18, 1990

Dr. Geoff Thornton
 Chemistry Department
 Manchester University
 Manchester M13 9PL
 United Kingdom

" H_2O Adsorption on BSSCO (001) and Other
 Oxide Surfaces"

Dr. Rudolf Schubert
 Room 3X 215
 Bellcore
 P. O. Box 7040
 Red Bank, NJ 07701-7040

"The Effect of Relative Humidity on
 Electrical Contacts"

Dr. Richard Kurtz
 Surface Science Division
 National Institute for Science
 and Technology
 Gaithersburg, MD 20899

"The Role of Surface Defects in Water
 Chemisorption on $TiO_2(110)$ "

Dr. Ben Ocko
Department of Physics
Brookhaven National Laboratory
Upton, Long Island, NY 11973

"In-Situ X-ray Scattering Investigations
of Electrode Surface Reconstructions"

Dr. Brian Maschhoff
Department of Physics
Laboratory for Surface Modification
Rutgers, The State University of
New Jersey
P. O. Box 849
Piscataway, NJ 08855-90849

"Interaction of Water with Insulator
Surfaces"
(Authors: Brian Maschhoff, J. M. Pan,
M. Szymonski and T. E. Madey)

Dr. D. R. Baer
Surface Physics Group
Battelle Pacific NW Lab
Battelle Blvd.
Richland, WA 99352

"Interactions of H_2O and Mn with the
Cleavage Surface of $CaCO_3$ "
(Authors: D. R. Baer, D. L. Blanchard
and J. M. Zachara)

Prof. Andrej Wieckowski
Department of Chemistry
University of Illinois
Urbana, IL 61801

"Voltammetry and Surface Science of
Rh(100) and Rh(111) Surfaces"

Dr. Masakatsu Watanabe
Department of Chemistry
University of Pennsylvania
Philadelphia, PA 19104-6323

"Phase Transition of Water Between
Metal Surfaces"

Dr. Fred Wagner
Physical Chemical Dept.
General Motors Research Labs
30500 Mound Road
Warren, MI 48090-9055

"Hydrogen and Water Coadsorption on
 $Cu(110)$ and $Pt(111)$: the Formation
of H_3O^+ ?"

Prof. J. Michael White
Department of Chemistry
University of Texas
Austin, Texas 78712

"Optical Absorption of $H_2O(g)$ and
Amorphous Ice"

Dr. Patricia M. George
Aerojet Electro Systems
Surface and Contam. Dept.
P. O. Box 296
Azusa, CA 91702

"The Reaction of Water on $GaAs(100)$ "

Dr. Patricia M. George
Aerojet Electro Systems
Surface and Contam. Dept.
P. O. Box 296
Azusa, CA 91702

"An XPS Study of Water Removal from
Be at 160K: Evidence for Ion Beam-
Induced Oxidation"

Prof. Doug Doren
Department of Chemistry
University of Delaware
Newark, DE 19716

"Molecular Diffusion on Solid Surfaces:
How Chemisorbed Molecules Differ from
Atoms"

GORDON RESEARCH CONFERENCES

FUNDAMENTAL INTERACTION OF WATER WITH SOLID SURFACES

Kimball Union Academy, Meriden, N.H. 03770

July 16 - 20, 1990

<p>Anton, A. Brad DR 315 Cornell University Chemical Engineering, Olin Hall Ithaca, NY 14853-5201</p>	<p>Bunker, Bruce Bry 303 Sandia National Labs. Org. 1842 Albuquerque, NM 87185</p>
<p>Raer, Don DR 311 Batelle, PNL PO Box 999 MS/K2-57 Richland, VA 99352</p>	<p>Bushby, Stephen DR 215 U. Western Ontario Dept of Chemistry London, Ontario N6A 5B7 CANADA</p>
<p>Baloga, Michael OFF Du Pont de Nemours & Company Inc. PO Box Drawer 219 No. 1 DuPont Road New Johnsonville, TN 37134</p>	<p>Callen, Brian DR 215 University of Western Ontario Interface Science Western Dept of Chemistry London, Ontario N6A 5B7 CANADA</p>
<p>Benndorf, Carsten Mikula 102 University of Hamburg Bunderstrasse 45 Dept of Physical Chemistry Hamburg 13 D-2000 F.R.G.</p>	<p>Campbell, Charles DR 216 University of Washington Chemistry Dept. BG-10 Seattle, WA 98195</p>
<p>Blanchard, David DR 312 Batelle, PNL PO Box 999 MS/K2-57 Richland, VA 99352</p>	<p>Chabal, Yves DR 402 AT&T Bell Labs. Room 1C-462 600 Mountain Avenue Murray Hill, NJ 07974-2070</p>
<p>Bonzel, H.P. DR 207 IGV, Forschungszentrum Julich Postfach 1913 Julich 5170 GERMANY</p>	<p>Chang, Si-Chung DR 410 Purdue University Box 362 Dept of Chemistry West Lafayette, IN 47907</p>
<p>Brodsky, Anatol Kilton 101 University of Pennsylvania Dept of Chemistry Philadelphia, PA 19104-6323</p>	<p>Doren, Doug DR 401 University of Delaware Dept of Chemistry Newark, DE 19716</p>
<p>Brosseau, Robert DR 315 Universite de Montreal Departement de Chimie CP 1228, Succ A Montreal, Quebec H3C 3J7 CANADA</p>	<p>Dubois, Lawrence DR 309 AT&T Bell Laboratories 600 Mountain Avenue Room 1D-245 Murray Hill, NJ 07974</p>
	<p>Fisher, Galen Bry 301 General Motors Research Labs. Physical Chemistry Dept 30500 Mound Road Warren, MI 48090-9055</p>

Garofalini, Stephen Mikula 103
Rutgers University
College of Engineering, Dept of Ceramic
Krett & Bowser Road
Piscataway, NJ 08855-0909

George, Patricia Mikula 205
Aerojet Electrosystems
Surface & Contam. Dept.
PO Box 296
Azusa, CA 91702

Griffiths, Keith Kilton 104
University of Western Ontario
Dept of Chemistry
London, Ontario N6A 5B7
CANADA

Harrington, D.A. DR 314
University of Victoria
Chemistry Department
Box 1700
Victoria, B.C. V8W 2Y2
CANADA

Heinzinger, Karl DR 404
Max-Planck-Inst. fur Chemie
Phys Chemie
Saarstrabe 23
6500 Mainz
F.R.G.

Henrich, Victor DR 208
Applied Physics/Yale University
PO Box 2157
15 Prospect St.
New Haven, CT 06520

Heras, Jose Maria Kilton 107
Univ. of La Plata
Diag. 113 Y 64
PO Box C.C. 16 Suc. 4
La Plata 1900
ARGENTINA

Hseuh, Kan-Lin DR 312
AMP
MS 021-001
PO Box 3608
Harrisburg, PA 17105-3608

Hulley, J.W. Bry 304
University of Minnesota
School of Physics and Astronomy
Minneapolis, MN 55455

Hung, Wei-Hsiu DR 407
Princeton Univ.
Dept of Chemistry
Princeton, NJ 08544

Kasemo, Bengt
Chalmers University of Technology
Dept of Physics
Goteborg S-412 96
SWEDEN

Kurtz, Richard DR 301
Surface Science Div.
NIST
Gaithersburg, MD 20899

Lackey, Damian DR 310
Fritz-Haber-Institut M.P.G.
Faradayweg 4-6
Berlin 33/ Dahlem 1000
F.R.G.

Landman, Uzi DR 211
Georgia Institute of Technology
School of Physics
Atlanta, GA 30332

Lawn, Brian DR 415
Institute of Standards & Technology
Ceramics Division
Rockville, MD 20899

Li, Yao-En DR 414
American Air Ligide
5230 S. East Avenue
Countryside, IL 60525

Madey, Theodore Mikula
Rutgers Univ.
Serin Physics Laboratory
PO Box 849
Piscataway, NJ 08855-0849

Maschoff, Brian Mikula
Rutgers University
Dept of Physics
Serin Physics Lab.
Piscataway, NJ 08855

Norton, P.R. DR 314
University of Western Ontario
Dept of Chemistry
London, Ontario N6A 5B7
CANADA

Ocko, Ben
Brookhaven Labs.
510B
Upton, NY 11973

DR 406

Schubert, Rudolf
Bellcore Room 3X215
PO Box 7040
331 Newman Springs Road
Red Bank, NJ 07736

Kilton 109

Panitz, John
The University of New Mexico
Physics and Astronomy
800 Yale Blvd. NE
Albuquerque, NM 87131

DR 305

Schulze, Paul
Abilene Christian University
Dept. of Physics
ACU Station Box 7963
Abilene, TX 79699

Kilton 109

Parks, Eric
Argonne National Lab.
9700 S. Cass Ave.
Bldg. 200
Argonne, IL 60439

DR 308

Shnloman, Yitzhak
Eastman Kodak Company
Research Labs. 83/2
Rochester, NY 14650-2216

Peterson, Charlie
FSI International
322 Lake Hazeltine Drive
Chaska, MN 55318

DR 409

Sinclair, J.W.
AT&T Bell Labs.
Room 1D 259
600 Mountain Avenue
Murray Hill, NJ 07974

DR 210

Pirug, G.
Inst. f Grenzflächenforschung U
Vakuumphysik Forschungszentrum Jülich
Postfach 1913
Jülich D-5170
GERMANY

DR 209

Spoehr, Eckhard
Univ. of California
Dept of Chemistry
Irvine, CA 92717

DR 403

Porter, John
University of California, Berkeley
Dept. of Chemistry
Berkeley, CA 94720

DR 307

Stuve, Eric
University of Washington
Dept of Chemical Engineering, BF-10
Seattle, WA 98195

DR 216

Robbins, Mark
Johns Hopkins University
Dept of Physics and Astronomy
34th and Charles St.
Baltimore, MD 21218

DR 217

Tao, Hui-Shu
Rutgers University
Physics Dept.
PO Box 849
Piscataway, NJ 08855-0849

DR 405

Ross, Philip
Lawrence Berkeley Laboratory
Materials & Chemicals Sciences Div.
Building 2-100
Berkeley, CA 94720

Thiel, Patricia
Ames Lab and Iowa State University
Dept of Chemistry
Alli Gilman Hall
Ames, IA 50011

Mikula 201

Schick, Michael
University of Washington
Physics Dept FM-15
Seattle, WA 98195

Thornton, G.
Manchester University
Chemistry Dept.
Manchester, M13 9PL
UNITED KINGDOM

Wagner, Frederick Bry 302
General Motors Research Labs.
Physical Chemistry Dept.
30300 Mound Rd.
Warren, MI 48090-9055

Wan, Kai-Tak DR 416
University of Maryland
Room A335 Bldg. 223
National Inst. Standards & Tech.
Gaithersburg, MD 20899

Watanabe, Masakatsu DR 306
University of Pennsylvania
Dept. of Chemistry
Philadelphia, PA 19104

Weaver, Michael DR 408
Purdue University
Dept of Chemistry
West Lafayette, IN 47907

White, J.M. Bry 305
University of Texas
Dept of Chemistry
Austin, TX 78712

Wieckowski, Andrej Welch 3
University of Illinois
Dept of Chemistry
1209 W. California Street
Urbana, IL 61801

Yates, John Jr. DR 303
University of Pittsburgh
Dept of Chemistry
Pittsburgh, PA 15260